

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Application of :
Akihiro IINO et al. :
Serial No. [not yet assigned -- :
Rule 53(b) :
Continuation of :
Application S.N. :
09/177,455 :
filed June 15, 2000] : Group Art Unit - 2834
Filed: November 21, 2001 : Examiner - Peter Medley
For: ULTRASONIC MOTOR AND :
ELECTRONIC APPARATUS :
EQUIPPED WITH ULTRA- :
SONIC MOTOR : Docket No. S004-3509 (CON)

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COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, DC 20231

**PRELIMINARY AMENDMENT FORMING PART
OF RULE 53(b) CONTINUATION APPLICATION**

S I R:

Pursuant to 37 CFR §1.53(b) and MPEP §201.06(a),
applicants preliminarily amend their application as follows:

IN THE SPECIFICATION:

Please replace the paragraph beginning at page 1, line 12,
after the title with the following rewritten paragraph:

--An ultrasonic motor utilizing stretching vibration
BY EXPRESS MAIL ON NOVEMBER 21, 2001 (ET 256 765 549 US)

and bending vibration of rectangular piezoelectric vibrators (dual-mode vibrator) in particular is used in various uses because it is capable of moving an object linearly or rotatably by combined vibration of those two vibrations. An ultrasonic motor of a type in which piezoelectric bodies are layered is also used where a high output is required (see Japanese Patent Laid-Open No. Hei. 7-184382).--

Please replace the paragraph beginning at page 1, line 20, with the following rewritten paragraph:

--FIG. 16 shows an ultrasonic motor of a type in which rectangular plate-like piezoelectric bodies are layered. A basic vibrator of the ultrasonic motor comprises piezoelectric bodies 61, 62, 63, 64, 65 and 66 which are polarized in a predetermined manner so as to vibrate in the dual mode and are layered in the polarizing direction, output fetching members 71, 72, 73, 74, 75 and 76 provided on edge portions 61a, 62a, 63a, 64a, 65a and 66a provided in the direction vertical to the polarizing direction of the piezoelectric bodies 61 through 66, and electrodes (not shown) provided on both sides of the piezoelectric bodies 61 through 66. The six piezoelectric vibrators, i.e., the piezoelectric bodies of two rows arrayed in the horizontal direction and stacked in three layers in the vertical direction, are held by coupling means 67, 68 and 69.--

Please replace the paragraph beginning at page 4, line 5, with the following rewritten paragraph:

--In order to achieve the above-mentioned objectives, an inventive ultrasonic motor comprises a first piezoelectric body having a first polarized portion excited when voltage is applied and a second piezoelectric body that is laminated with the first piezoelectric body in the longitudinal direction parallel to the polarizing direction. The second piezoelectric body has a first polarized portion at a position separated from the first polarized portion of the first piezoelectric body in the transverse direction vertical to the polarizing direction, and moves a moving body by stretching vibration and bending vibration caused by vibrations of the first polarized portion of the first piezoelectric body and the first polarized portion of the second piezoelectric body in the longitudinal direction.--

Please replace the paragraph beginning at page 4, line 19, with the following rewritten paragraph:

--The polarized portion of the first piezoelectric body and the polarized portion of the second piezoelectric body excite in the vertical and horizontal directions, respectively. The stretching vibration is then produced when the respective vibrations in the longitudinal direction

overlap and the bending vibration is produced from the implication between the transverse vibrations and the stretching vibration therearound. The moving body is then moved by elliptic vibration obtained by combining the stretching vibration and the bending vibration.--

Please replace the paragraph beginning at page 5, line 14, with the following rewritten paragraph:

--The invention is further characterized in that the first and second piezoelectric bodies have second polarized portions further at positions corresponding to the first polarized portions.

Please replace the paragraph beginning at page 5, line 19, with the following rewritten paragraph:

--Thereby, elliptic vibration for rotating in the reverse direction may be taken out by exciting only the second polarized portions of the respective piezoelectric bodies to produce bending vibration having a different phase, for example. Alternatively, the bending vibration may be amplified by exciting the second polarized portion with a different phase from the first polarized portion in the same time. Accordingly, driving force in both normal and reverse directions may be obtained and the output may be controlled by displacing the bending vibration or by changing the phase.--

Please replace the paragraph beginning at page 6, line 4, with the following rewritten paragraph:

--The invention is further characterized in that a third piezoelectric body which vibrates in the same phase with the stretching vibration is laminated in a body of the ultrasonic motor.--

Please replace the paragraph beginning at page 6, line 13, with the following rewritten paragraph:

--The invention is further characterized in that a third polarized portion that vibrates in the same phase with the stretching vibration is provided between the first polarized portion of the first piezoelectric body and the first polarized portion of the second piezoelectric body at least in either one of the first piezoelectric body and the second piezoelectric body. Thereby, the third polarized portion vibrates in the longitudinal direction in the same phase with the stretching vibration and amplifies the stretching vibration. Accordingly, the high-output ultrasonic motor may be realized.--

Please replace the paragraph beginning at page 7, line 3, with the following rewritten paragraph:

--The invention described is further characterized in that the moving body of the ultrasonic motor is abutted to

the laminated piezoelectric vibrator in the horizontal direction in the.

Paragraph beginning at line 10 of page 7 has been amended as follows:

--The invention is further characterized in that the laminated piezoelectric vibrator is abutted at least at one point of a spherical moving body of the ultrasonic motor described in any one of the foregoing embodiments.--

Please replace the paragraph beginning at page 7, line 14, with the following rewritten paragraph:

--Thereby, the spherical moving body may be moved about an arbitrary axis by applying a driving force to one point of the spherical moving body by the laminated piezoelectric vibrator or may be moved arbitrary by applying a driving force to a plurality of points.--

Please replace the paragraph beginning at page 7, line 19, with the following rewritten paragraph:

--The invention is further characterized in that an electronic apparatus equipped with the ultrasonic motor comprises the ultrasonic motor described in any one of the foregoing embodiments. Thereby, the electronic apparatus

equipped with the ultrasonic motor having the ultrasonic motor as a driving source may be realized.--

Please replace the paragraph beginning at page 12, line 3, with the following rewritten paragraph:

--Planar electrodes 21 are fixed on one end face of the respective piezoelectric bodies 11A through 11E at a region corresponding to polarization and reference electrodes 22 are fixed on the face of the respective piezoelectric bodies 12A through 12E facing [to] the planar electrodes 21 of the piezoelectric bodies 11A through 11E as counter electrodes.--

Please replace the paragraph beginning at page 12, line 13, with the following rewritten paragraph:

--It is noted that the piezoelectric body 11A as a first piezoelectric body of the invention is identical with the piezoelectric bodies 11B and 11C and the piezoelectric body 11D as a second piezoelectric body of the invention is identical with the piezoelectric body 11E. The piezoelectric body 12A is also identical with the piezoelectric bodies 12B through 12E, so that only the piezoelectric bodies 11A and 11D and the piezoelectric bodies 12A and 12D which are paired with them will be explained below as the representative piezoelectric bodies.

Please replace the paragraph beginning at page 14, line 14, with the following rewritten paragraph:

--Here, the side electrode 32 is connected to the planar electrodes 21b of the piezoelectric bodies 11A through 11C, the side electrode 33 is connected to the reference electrodes 22a and 22b of the piezoelectric bodies 12A through 12E and the side electrode 34 is connected to the planar electrodes 21c of the piezoelectric bodies 11D and 11E. Meanwhile, the side electrode 35 is connected to the planar electrodes 21a of the piezoelectric bodies 11A through 11C and the side electrode 36 is connected to the planar electrodes 21d of the piezoelectric bodies 11D and 11E.--

Please replace the paragraph beginning at page 15, line 22, with the following rewritten paragraph:

--Here, an electric-mechanical coupling coefficient of the piezoelectric longitudinal effect is greater than that of the piezoelectric transverse effect, and an overall energy efficiency is enhanced by utilizing the piezoelectric longitudinal effect.--

Please replace the paragraph beginning at page 17, line 15, with the following rewritten paragraph:

--At this time, when the polarized portions 21b of the piezoelectric bodies 11A through 11C and the polarized

portions 11c of the piezoelectric bodies 11D and 11E contract in the longitudinal direction, for example, it corresponds to stretching of the polarized portions 11a of the piezoelectric bodies 11A through 11C and the polarized portions 11d of the piezoelectric bodies 11D and 11E in the longitudinal direction.--

Please replace the paragraph beginning at page 18, line 24, with the following rewritten paragraph:

--FIGs. 5 and 6 show a second embodiment in which the present invention is applied to an ultrasonic motor, wherein Figs. 5a through 5f show a basic laminating structure of the vibrating body 10 and FIGs. 6a and 6b show disposition of side electrodes.--

Please replace the paragraph beginning at page 19, line 4, with the following rewritten paragraph:

--As shown in FIGs. 5a, 5b, 5e and 5f, the piezoelectric bodies 11A and 11B and the piezoelectric bodies 12A and 12C which are paired with one another are constructed almost in the same manner as in the first embodiment, so that their explanation will be omitted here.--

**Please replace the paragraph beginning at page 22, line 8,
with the following rewritten paragraph:**

--It is also possible to apply different voltages to the respective groups to vary the elliptic vibration drawn by the output fetching member 31.--

**Please replace the paragraph beginning at page 22, line 20,
with the following rewritten paragraph:**

--As shown in FIGs. 7b and 7d, the piezoelectric bodies 12A and 12B which are paired with piezoelectric bodies 14A and 14B are constructed almost in the same manner as in the first embodiment, so that their explanation will be omitted here.--

**Please replace the paragraph beginning at page 23, line 1,
with the following rewritten paragraph:**

--The present embodiment is characterized in that rectangular planes of the piezoelectric bodies 14A and 14B as first and second piezoelectric vibrators are divided into three parts and planar electrodes 24a through 24c and 24d through 24f are fixed corresponding to the respective divided planes 14a through 14c and 14d through 14f as shown in FIGs. 7a and 7c. Then, a polarization process is implemented on the respective divided planes 14a through 14c and 14d through 14f

by setting the front page side thereof as plus and the back side thereof as minus and by applying a voltage exceeding a resistive electric field to the planar electrodes 21a through 21d.--

Please replace the paragraph beginning at page 30, line 16, with the following rewritten paragraph:

--As shown in FIGs. 11b, 11c, 11d and 11f, the present embodiment are constructed almost in the same manner as in the second embodiment, so that the explanation on the piezoelectric body 13A, piezoelectric bodies 12A, 12B and 12C will be omitted here.--

Please replace the paragraph beginning at page 34, line 1, with the following rewritten paragraph:

--While the present embodiment is constructed almost in the same manner as in the first embodiment, it is characterized in that the vibrating body 10 is fixed, a pair of output fetching members 38 and 39 are fixed at the edge portion thereof in the direction vertical to the laminating direction and the output fetching members 38 and 39 are abutted with a moving body 54.--

**Please replace the paragraph beginning at page 34, line 22,
with the following rewritten paragraph:**

--Here, the vibrating bodies 10A and 10B have the same laminating structure and disposition of electrodes as in the second embodiment and only the stretching vibration, only the bending vibration or the combined elliptic vibration may be produced by selecting the electrodes to which voltage is applied.--

**Please replace the paragraph beginning at page 35, line 5,
with the following rewritten paragraph:**

--The spherical rotor 55 may be moved in triaxial directions by vibrating both vibrating bodies 10A and 10B. At this time, the output fetching members 31A and 31B cause elliptic vibration, respectively. The output fetching member 31A applies frictional force in the direction of rotation about the Z-axis of the spherical rotor 55 and the output fetching member 31B applies frictional force in the direction of rotation about the X-axis of the spherical rotor 55. The spherical rotor 55 rotates about the X and Z-axes in the same time, thus realizing the triaxial movement.--

**Please replace the paragraph beginning at page 35, line 19,
with the following rewritten paragraph:**

--At this time, the output fetching member 31A

applies frictional force to the spherical rotor 55 in the direction of rotation about the Z-axis and the output fetching member 31B stretches and applies force only in the direction of the center of the spherical rotor 55, so that they do not hamper the spherical rotor 55 from rotating about the Z-axis.--

Please replace the paragraph beginning at page 36, line 9, with the following rewritten paragraph:

--The electronic apparatus comprises the above-mentioned vibrating body 10, a moving body 61 moved by the vibrating body 10, a pressurizing mechanism 62 moved by the vibrating body 10, a pressurizing mechanism 62 for applying pressurizing force to the moving body 61 and the vibrating body 10, a transmission mechanism 63 operating in linkage with the moving body 61 and an output mechanism 64 that moves based on the operation of the transmission mechanism 63.--

Please replace the paragraph beginning at page 36, line 16, with the following rewritten paragraph:

--Here, a transmission wheel such as a gear and a frictional gear is used as the transmission mechanism 63. As the output mechanism 64, a shutter driving mechanism and a lens driving mechanism are used in the case of a camera, for

example, a needle driving mechanism and a calendar driving mechanism are used in case of an electronic watch, and a cutter feeding mechanism and a workpiece feeding mechanism are used in case of a work machine.--

Please replace the paragraph beginning at page 37, line 7, with the following rewritten paragraph:

--As described above, according to the invention, the inventive ultrasonic motor is arranged such that the polarized portion of the first piezoelectric body and the polarized portion of the second piezoelectric body stretch respectively in the polarizing direction so that stretching vibration and bending vibration are produced by overlapping the respective vibrations in the longitudinal direction. The output may be increased by utilizing the vibration in the longitudinal direction caused by the piezoelectric longitudinal effect and electrical energy may be utilized very efficiently.--

Please replace the paragraph beginning at page 37, line 24, with the following rewritten paragraph:

--According to the invention, a driving force in both normal and reverse directions may be obtained and the output may be controlled by displacing the bending vibration

or by changing the phase because the elliptic vibration for rotating in the reverse direction is taken out by causing bending vibration having a different phase or by amplifying the bending vibration by exciting the second polarized portion with a phase different from the first polarized portion in the same time.--

Please replace the paragraph beginning at page 38, line 8, with the following rewritten paragraph:

--According to the invention, by providing a third piezoelectric body which vibrates in the same phase with the stretching vibration, the high-output ultrasonic motor may be realized because the stretching vibration is amplified.--

Please replace the paragraph beginning at page 38, line 11, with the following rewritten paragraph:

--According to the invention, by providing a third polarized portion that vibrates in the same phase with the stretching vibration, the high-output ultrasonic motor may be realized because the stretching vibration is amplified.--

Please replace the paragraph beginning at page 38, line 14, with the following rewritten paragraph:

--According to the invention by abutting the moving body to the laminated piezoelectric vibrator in the horizontal

direction, the moving body may be moved in the horizontal direction of the piezoelectric vibrator.--

Please replace the paragraph beginning at page 38, line 17, with the following rewritten paragraph:

--According to the invention by abutting the laminated piezoelectric vibrator at least at one point of a spherical moving body of the ultrasonic motor, the spherical moving body may be moved arbitrary.--

Please replace the paragraph beginning at page 38, line 19, with the following rewritten paragraph:

--According to another aspect of the invention, an electronic apparatus using the ultrasonic motor may be realized.--

IN THE CLAIMS:

Kindly amend claim 1 as follows:

1. (Amended) An ultrasonic motor having a movable member frictionally driven by ultrasonic vibration of a vibrating body, the ultrasonic motor comprising:

a vibrating body polarized in a given direction and comprised of a first piezoelectric body, a second piezoelectric body laminated to the first piezoelectric body

in a preselected direction generally parallel to the polarized direction, and a third piezoelectric body disposed between the first and second piezoelectric bodies, each of the first and second piezoelectric bodies having a first polarized portion and a second polarized portion, the first polarized portion of the first piezoelectric body being aligned in the preselected direction with the second polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the first polarized portion of the second piezoelectric body, and the second polarized portion of the first piezoelectric body being aligned in the preselected direction with the first polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the second polarized portion of the second piezoelectric body; and

a movable member frictionally driven by a combination of a stretching vibration and a bending vibration generated by applying a driving signal having a first phase to the first polarized portions of the first and second piezoelectric bodies and applying a driving signal having a second phase different from the first phase to the second polarized portions of the first and second piezoelectric bodies, the third piezoelectric body undergoing vibration in a phase identical to that of the stretching vibration.

Kindly add the following new claims 8-12:

8. An ultrasonic motor comprising: a plurality of vibrational bodies for generating stretching and bending vibrations, at least one of the vibrational bodies generating only the stretching vibration; and a movable member disposed in contact with the vibrational bodies and frictionally driven by a combination of the stretching and bending vibrations generated by the vibrational bodies.

9. An ultrasonic motor according to claim 8; wherein the plurality of vibrational bodies comprises two vibrational bodies.

10. An ultrasonic motor according to claim 9; wherein the vibrational bodies are disposed generally perpendicular to one another other.

11. An ultrasonic motor according to claim 8; further comprising a plurality of transmission members for transmitting the stretching and bending vibrations generated by the vibrational bodies to the movable member.

12. An ultrasonic motor according to claim 8; wherein the plurality of vibrational bodies comprises a first piezoelectric body and a second piezoelectric body, each of the first and second piezoelectric bodies having a first

polarized portion and a second polarized portion, the first polarized portion of the first piezoelectric body being aligned in a preselected direction with the second polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the first polarized portion of the second piezoelectric body, and the second polarized portion of the first piezoelectric body being aligned in the preselected direction with the first polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the second polarized portion of the second piezoelectric body.

IN THE ABSTRACT:

Delete the abstract now of record and insert therefor the new abstract submitted herewith on a separate sheet.

IN THE DRAWINGS:

Submitted herewith are copies of Figs. 4 and 5C on which have been marked in red proposed drawing revisions. Upon approval of the drawing revisions and allowance of the application, the formal drawings will be accordingly revised.

ADDITIONAL FEES:

No additional fees are believed required; however, should it be determined that a fee is due, authorization is hereby given to charge any such fee to our Deposit Account No. 01-0268.

REMARKS

The present application is a Rule 53(b) continuation of parent application Serial No. 09/177,455, filed June 15, 2000, and is being filed to pursue the subject matter of claims 9, 10 and 32 which were rejected in the Office Action dated September 12, 2000 and the Office Action dated June 20, 2001 in the parent application. Claims 3, 4, 8, 11, 12, 14, 15, 21, 22, 24, 25, 29-31 and 33-38 have been allowed in the parent application.

The present preliminary amendment is being filed to advance prosecution by amending independent claim 1 to recite the combination recited in claims 9-10, adding new claim 8 directed to the subject matter of claim 32, and responding to the rejections raised by the Examiner in the September 12, 2000 and June 20, 2001 Office Actions in the parent application.

In the Office Action dated September 12, 2000 issued in the parent application, the Examiner rejected claims 9 and

10 under 35 U.S.C. §102(b) as being anticipated by Funakubo et al. ("Funakubo"). In the Office Action dated June 20, 2001 issued in the parent application, the Examiner rejected claim 32 under 35 U.S.C. §102(b) as being anticipated by Japanese Patent No. 02-007875 ("Japan '875").

By the present amendment, independent claim 1 has been amended to recite the subject matter of claims 9 and 10 in the parent application. New independent claim 8 has been added to cover the subject matter of independent claim 32 in the parent application. New claims 9-12 have been added to provide a fuller scope of coverage.

The specification and drawings have been amended to reflect all of the revisions made during prosecution of the parent application. A new abstract which more clearly reflects the invention to which the claims are directed has been substituted for the original abstract.

Attached hereto is a marked-up version of the changes made to specification and independent claim 1 by the current amendment. The attached pages xviii are captioned **"VERSION WITH MARKINGS TO SHOW CHANGES MADE."**

Applicants respectfully request reconsideration of the subject matter of claims 9-10 and 32 in the parent application, now the subject matter of amended independent claim 1 and independent claim 8, respectively, in this application, in view of the following discussion.

The present invention is directed to an ultrasonic motor.

An embodiment of the ultrasonic motor according to the present invention embodied in the claims is shown in Figs. 1-4. The ultrasonic motor comprises a vibrational body 10 polarized in a given direction. The vibrational body 10 comprises a first piezoelectric body 11A, a second piezoelectric body 11D laminated to the first piezoelectric body 11A in a preselected direction generally parallel to the polarized direction, and a third piezoelectric body 12A. The first piezoelectric body 11A has a first polarized portion 11a and a second polarized portion 11b. The second piezoelectric body 11D has a first polarized portion 11d and a second polarized portion 11c. The first polarized portion 11a of the first piezoelectric body 11A is aligned in the preselected direction with the second polarized portion 11c of the second piezoelectric body 11D and is disposed in non-overlapping relation with the first polarized portion 11d of the second piezoelectric body 11D. The second polarized portion 11b of the first piezoelectric body 11A is aligned in the preselected direction with the first polarized portion 11d of the second piezoelectric body 11D and is disposed in non-overlapping relation with the second polarized portion 11c of the second piezoelectric body 11D.

A movable member 50 is frictionally driven by a combination of a stretching vibration B and a bending vibration A generated by applying a driving signal having a first phase to the first polarized portions 11a, 11d of the first and second piezoelectric bodies 11A, 11D and applying a driving signal having a second phase different from the first phase to the second polarized portions 11b, 11c of the first and second piezoelectric bodies 11A, 11D. The third piezoelectric body 12A undergoes vibration in a phase identical to that of the stretching vibration B.

Fig. 14 shows another embodiment of the ultrasonic motor according to the present invention embodied in the claims. The ultrasonic motor has two vibrational bodies 10A, 10B for generating stretching and bending vibrations, at least one of the vibrational bodies generating only the stretching vibration. A movable member 55 is disposed in contact with the vibrational bodies and is frictionally driven by a combination of the stretching and bending vibrations generated by the vibrational bodies 10A, 10B.

By the foregoing construction, an ultrasonic motor which is compact, which has a high energy converting efficiency, which can output a large vibration output and which is simple to manufacture is achieved.

Applicants respectfully submit that the prior art of record does not disclose or suggest the subject matter recited in amended independent claim 1 and newly added claims 8-12.

In the September 12, 2000 Office Action in the parent application, claims 9 and 10 were rejected under 35 U.S.C. §102(b) as being anticipated by Funakubo. By this preliminary amendment, independent claim 1 has been amended to recite the combination of claims 9 and 10 in the parent application. Applicants respectfully submit that amended independent claim 1 recites subject matter which is not identically disclosed or described in Funakubo.

Amended independent claim 1 is directed to an ultrasonic motor and requires a vibrating body polarized in a given direction and comprised of a first piezoelectric body, a second piezoelectric body laminated to the first piezoelectric body in a preselected direction generally parallel to the polarized direction, and a third piezoelectric body disposed between the first and second piezoelectric bodies, each of the first and second piezoelectric bodies having a first polarized portion and a second polarized portion, the first polarized portion of the first piezoelectric body being aligned in the preselected direction with the second polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the first polarized portion of the

second piezoelectric body, and the second polarized portion of the first piezoelectric body being aligned in the preselected direction with the first polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the second polarized portion of the second piezoelectric body. Claim 1 further requires a movable member frictionally driven by a combination of a stretching vibration and a bending vibration generated by applying a driving signal having a first phase to the first polarized portions of the first and second piezoelectric bodies and applying a driving signal having a second phase different from the first phase to the second polarized portions of the first and second piezoelectric bodies, the third piezoelectric body undergoing vibration in a phase identical to that of the stretching vibration.

Funakubo discloses a two-dimensionally driving ultrasonic motor. As shown in Fig. 23, the ultrasonic motor comprises a plurality of piezoelectric bodies 76a-76c laminated together and having polarized portions. In the embodiment of Figs. 13 and 14, for example, the piezoelectric bodies are designated with numerals 81, 82 and each has a pair of polarized portions 78 for receiving a driving signal. The polarized portions 78 of the piezoelectric body 81 are oriented generally perpendicular to, and thus overlap, the

polarized portions 78 of the piezoelectric body 82.

In contrast, independent claim 1 requires that the first polarized portion of the first piezoelectric body is aligned in the preselected direction with the second polarized portion of the second piezoelectric body and is disposed in non-overlapping relation with the first polarized portion of the second piezoelectric body, and that the second polarized portion of the first piezoelectric body is aligned in the preselected direction with the first polarized portion of the second piezoelectric body and is disposed in non-overlapping relation with the second polarized portion of the second piezoelectric body. Furthermore, Funakubo does not disclose or describe a third piezoelectric body disposed between the first and second piezoelectric bodies for undergoing vibration in a phase identical to that of the stretching vibration, as required by independent claim 1.

In the absence of the foregoing disclosure recited in independent claim 1, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to

establish unpatentability of the claimed invention anticipation under § 102 can not be found".); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by the Funakubo disclosure for the reasons stated above. Furthermore, Funakubo does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Funakubo's ultrasonic motor to arrive at the claimed invention.

In the June 20, 2001 Office Action in the parent application, the Examiner rejected claim 32 under 35 U.S.C. §102(b) as being anticipated by Japan '875. By this preliminary amendment, new independent claim 8 has been added to recite the subject matter of claim 32 in the parent application. Applicants respectfully submit that independent claim 32 recites subject matter which is not identically disclosed or described in Japan '875.

Independent claim 8 is directed to an ultrasonic motor and requires a plurality of vibrational bodies for generating stretching and bending vibrations, at least one of the vibrational bodies generating only the stretching vibration. Claim 8 further requires a movable member disposed in contact with the vibrational bodies and frictionally driven by a combination of the stretching and bending vibrations generated by the vibrational bodies.

Japan '875 discloses an ultrasonic oscillator having a vibrational body 20 comprised of a piezoelectric laminate member 25 (comprised of plate-like piezoelectric elements 21) and a piezoelectric element 22 (Fig. 1(a)). When the piezoelectric laminate member 25 and the piezoelectric element 22 are oscillated, the generated oscillations in longitudinal and transverse directions are synthesized and its synthesized condition is controlled. However, Japan '875 does not disclose or describe an ultrasonic motor having a plurality of vibrational bodies for generating stretching and bending vibrations, at least one of the vibrational bodies generating only the stretching vibration, as required by independent claim 8.

Since Japan '875 does not disclose or describe an ultrasonic motor having a plurality of vibrational bodies for generating stretching and bending vibrations where at

least one of the vibrational bodies generates only the stretching vibration, as required by independent claim 8, there can be no anticipation by Japan '875 of independent claim 8 under 35 U.S.C. §102(b). That is, since each and every limitation of independent claim 8 is not found in Japan '875, the reference does not anticipate the claimed invention. See In re Lange, 209 USPQ 288, 293 (CCPA 1981). Furthermore, Japan '875 does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Japan '875's ultrasonic oscillator to arrive at the claimed invention.

New claims 9-12 depend on and contain all of the limitations of independent claim 8 and, therefore, distinguish from the reference at least in the same manner as claim 8.

In view of the foregoing amendments and discussion, applicants respectfully submit that the application is now in condition for allowance. Accordingly, favorable

reconsideration and allowance of the claims are most
respectfully requested.

Respectfully submitted,

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ABSTRACT OF THE DISCLOSURE

An ultrasonic motor has vibrational bodies for generating stretching and bending vibrations, at least one of the vibrational bodies generating only the stretching vibration. A movable member is disposed in contact with the vibrational bodies and is frictionally driven by a combination of the stretching and bending vibrations generated by the vibrational bodies.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Paragraph beginning at line 12 of page 1 has been amended as follows:

An ultrasonic motor utilizing stretching vibration and bending vibration of rectangular piezoelectric vibrators (dual-mode vibrator) in particular is used in various uses because it is capable of moving an object linearly or [rotably] rotatably by combined vibration of those two vibrations. An ultrasonic motor of a type in which piezoelectric bodies are layered is also used [for the use requiring] where a high output is required (see Japanese Patent Laid-Open No. Hei. 7-184382).

Paragraph beginning at line 20 of page 1 has been amended as follows:

FIG. 16 shows an ultrasonic motor of a type in which rectangular plate-like piezoelectric bodies are layered. A basic vibrator of the ultrasonic motor comprises piezoelectric bodies 61, 62, 63, 64, 65 and 66 which are polarized in a predetermined manner so as to vibrate in the dual mode and are layered in the polarizing direction, output fetching members 71, 72, 73, 74, 75 and 76 provided on edge portions 61a, 62a,

63a, 64a, 65a and 66a provided in the direction vertical to the polarizing direction of the piezoelectric bodies 61 through 66, and electrodes (not shown) provided on [the] both sides of the piezoelectric bodies 61 through 66. The six piezoelectric vibrators, i.e., the piezoelectric bodies of two rows arrayed in the horizontal direction and stacked in three layers in the vertical direction, are held by coupling means 67, 68 and 69.

Paragraph beginning at line 5 of page 4 has been amended as follows:

In order to achieve the above-mentioned objectives, an inventive ultrasonic motor comprises[, as described in Claim] [1,] a first piezoelectric body having a first polarized portion excited when voltage is applied and a second piezoelectric body that is laminated with the first piezoelectric body in the longitudinal direction parallel to the polarizing direction. [and having] The second piezoelectric body has a first polarized portion at a position separated from the first polarized portion of the first piezoelectric body in the transverse direction vertical to the polarizing direction, and moves a moving body by [vibration] [into which] stretching vibration and bending vibration caused by vibrations of the first polarized portion of the first

piezoelectric body and the first polarized portion of the second piezoelectric body in the longitudinal direction.

Paragraph beginning at line 19 of page 4 has been amended as follows:

[Thereby, the] The polarized portion of the first piezoelectric body and the polarized portion of the second piezoelectric body excite in the vertical and horizontal directions, respectively. [Then, the] The stretching vibration is then produced when the respective vibrations in the longitudinal direction overlap and the bending vibration is produced from the implication between the transverse vibrations and the stretching vibration therearound. The moving body is then moved by elliptic vibration obtained by combining the stretching vibration and the bending vibration.

Paragraph beginning at line 14 of page 5 has been amended as follows:

The invention [described in Claim 2] is further characterized in that the first and second piezoelectric bodies have second polarized portions further at positions corresponding to the first polarized portions [of own in the invention described] [in Claim 1].

Paragraph beginning at line 19 of page 5 has been amended as follows:

Thereby, elliptic vibration for rotating in the reverse direction may be taken out by exciting only the second polarized portions of the respective piezoelectric bodies to produce bending vibration having a different phase, for example. [Or] Alternatively, the bending vibration may be amplified by exciting the second polarized portion with a different phase from the first polarized portion in the same time. Accordingly, driving force in both normal and reverse directions may be obtained and the output may be controlled by displacing the bending vibration or by changing the phase.

Paragraph beginning at line 4 of page 6 has been amended as follows:

The invention [described in Claim 3] is further characterized in that a third piezoelectric body which vibrates in the same phase with the stretching vibration is laminated in a body [in] of the ultrasonic motor [described in Claim 1].

Paragraph beginning at line 13 of page 6 has been amended as follows:

The invention [described in Claim 4] is further characterized in that a third polarized portion that vibrates

in the same phase with the stretching vibration is provided between the first polarized portion of the first piezoelectric body and the first polarized portion of the second piezoelectric body at least in either one of the first piezoelectric body and the second piezoelectric body. Thereby, the third polarized portion vibrates in the longitudinal direction in the same phase with the stretching vibration and amplifies the stretching vibration. Accordingly, the high-output ultrasonic motor may be realized.

Paragraph beginning at line 3 of page 7 has been amended as follows:

The invention described [in Claim 5] is further characterized in that the moving body of the ultrasonic motor is abutted to the laminated piezoelectric vibrator in the horizontal direction in the [ultrasonic motor] [described in Claim 1].

Paragraph beginning at line 10 of page 7 has been amended as follows:

The invention [described in Claim 6] is further characterized in that the laminated piezoelectric vibrator is abutted at least at one point of a spherical moving body [in] of the ultrasonic motor described in any one of [Claims 1 through 4] the foregoing embodiments.

Paragraph beginning at line 14 of page 7 has been amended as follows:

Thereby, the spherical moving body may be moved about an arbitrary axis by applying a driving force to one point of the spherical moving body by the laminated piezoelectric vibrator or may be moved arbitrary by applying a driving force to a plurality of points.

Paragraph beginning at line 19 of page 7 has been amended as follows:

The invention [described in Claim 7] is further characterized in that an electronic apparatus equipped with the ultrasonic motor comprises the ultrasonic motor described in any one of [Claims 1 through 6] the foregoing embodiments. Thereby, the electronic apparatus equipped with the ultrasonic motor having the ultrasonic motor as a driving source may be realized.

Paragraph beginning at line 3 of page 12 has been amended as follows:

Planar electrodes 21 are fixed on one end face of the respective piezoelectric bodies 11A through 11E at a region corresponding to polarization and reference electrodes 22 are fixed on the face of the respective piezoelectric

bodies 12A through 12E facing [to] the planar electrodes 21 of the piezoelectric bodies 11A through 11E as counter electrodes.

Paragraph beginning at line 13 of page 12 has been amended as follows:

It is noted that the piezoelectric body 11A as a first piezoelectric body of the invention is identical with the piezoelectric bodies 11B and 11C and the piezoelectric body 11D as a second piezoelectric body of the invention is identical with the piezoelectric body 11E. [and the] The piezoelectric body 12A is also identical with the piezoelectric bodies 12B through 12E, so that only the piezoelectric bodies 11A and 11D and the piezoelectric bodies 12A and 12D which are paired with them will be explained below as the representative piezoelectric bodies.

Paragraph beginning at line 14 of page 14 has been amended as follows:

Here, the side electrode 32 is connected to the planar electrodes 21b of the piezoelectric bodies 11A through 11C, the side electrode 33 is connected to the reference electrodes 22a and 22b of the piezoelectric bodies 12A through 12E and the side electrode 34 is connected to the planar

electrodes 21c of the piezoelectric bodies 11D and 11E.

Meanwhile [Meanwhile], the side electrode 35 is connected to the planar electrodes 21a of the piezoelectric bodies 11A through 11C and the side electrode 36 is connected to the planar electrodes 21d of the piezoelectric bodies 11D and 11E.

Paragraph beginning at line 22 of page 15 has been amended as follows:

Here, an electric-mechanical coupling coefficient of the piezoelectric longitudinal effect is greater than that of the piezoelectric transverse effect, and an overall energy efficiency is enhanced by utilizing the piezoelectric longitudinal effect.

Paragraph beginning at line 15 of page 17 has been amended as follows:

At this time, when the polarized portions 21b of the piezoelectric bodies 11A through 11C and the polarized portions 11c of the piezoelectric bodies 11D and 11E contract in the longitudinal direction, for example, it corresponds to [that] stretching of the polarized portions 11a of the piezoelectric bodies 11A through 11C and the polarized portions 11d of the piezoelectric bodies 11D and 11E [stretch] in the longitudinal direction.

Paragraph beginning at line 24 of page 18 has been amended as follows:

FIGs. 5 and 6 show a second embodiment in which the present invention is applied to an ultrasonic motor, wherein [FIGd.] Figs. 5a through 5f show a basic laminating structure of the vibrating body 10 and FIGs. 6a and 6b show disposition of side electrodes.

Paragraph beginning at line 4 of page 19 has been amended as follows:

As shown in FIGs. 5a, 5b, 5e and 5f, the piezoelectric bodies 11A and 11B and the piezoelectric bodies 12A and 12C which are paired with [them] one another are constructed almost in the same manner as in [with] the first embodiment, so that their explanation will be omitted here.

Paragraph beginning at line 8 of page 22 has been amended as follows:

It is also possible to apply different voltages to the respective groups to [variegate] vary the elliptic vibration drawn by the output fetching member 31.

Paragraph beginning at line 20 of page 22 has been amended as follows:

As shown in FIGs. 7b and 7d, the piezoelectric bodies 12A and 12B which are paired with piezoelectric bodies 14A and 14B are constructed almost in the same manner as in [with] the first embodiment, so that their explanation will be omitted here.

Paragraph beginning at line 1 of page 23 has been amended as follows:

The present embodiment is characterized in that rectangular planes of the piezoelectric bodies 14A and 14B as first and second piezoelectric vibrators are divided into three parts and planar electrodes 24a through 24c and 24d through 24f are fixed corresponding to the respective divided planes 14a through 14c and 14d through 14f as shown in FIGs. 7a and 7c. Then, a polarization process is implemented on the respective divided planes 14a through 14c and 14d through [14] 14f by setting the front page side thereof as plus and the back side thereof as minus and by applying a voltage exceeding a resistive electric field to the planar electrodes 21a through 21d.

Paragraph beginning at line 16 of page 30 has been amended as follows:

As shown in FIGs. 11b, 11c, 11d and 11f, the present embodiment are constructed almost in the same manner [with] as in the second embodiment, so that the explanation on the piezoelectric body 13A, piezoelectric bodies 12A, 12B and 12C will be omitted here.

Paragraph beginning at line 1 of page 34 has been amended as follows:

While the present embodiment is constructed almost in the same manner [with] as in the first embodiment, it is characterized in that the vibrating body 10 is fixed, a pair of output fetching members 38 and 39 are fixed at the edge portion thereof in the direction vertical to the laminating direction and the output fetching members 38 and 39 are abutted with a moving body 54.

Paragraph beginning at line 22 of page 34 has been amended as follows:

Here, the vibrating bodies 10A and 10B have the same laminating structure and disposition of electrodes [with] as in the second embodiment and only the stretching vibration, only the bending vibration or the combined elliptic vibration

may be produced by selecting the electrodes to which voltage is applied.

Paragraph beginning at line 5 of page 35 has been amended as follows:

The spherical rotor 55 may be moved in triaxial directions by vibrating [the] both vibrating bodies 10A and 10B. At this time, the output fetching members 31A and 31B cause elliptic vibration, respectively. The output fetching member 31A applies frictional force in the direction of rotation about the Z-axis of the spherical rotor 55 and the output fetching member 31B applies frictional force in the direction of rotation about the X-axis of the spherical rotor 55. The spherical rotor 55 rotates about the X and Z-axes in the same time, thus realizing the triaxial movement.

Paragraph beginning at line 19 of page 35 has been amended as follows:

At this time, the output fetching member 31A applies frictional force to the spherical rotor 55 in the direction of rotation about the Z-axis and the output fetching member 31B stretches and applies force only in the direction of the center of the spherical rotor 55, so that they do not hamper the spherical rotor 55 from rotating [centering on] about the Z-axis.

Paragraph beginning at line 9 of page 36 has been amended as follows:

The electronic apparatus [is realized by comprising] comprises the above-mentioned vibrating body 10, a moving body 61 moved by the vibrating body 10, a pressurizing mechanism 62 moved by the vibrating body 10, a pressurizing mechanism 62 for applying pressurizing force to the moving body 61 and the vibrating body 10, a transmission mechanism 63 operating in linkage with the moving body 61 and an output mechanism 64 that moves based on the operation of the transmission mechanism 63.

Paragraph beginning at line 16 of page 36 has been amended as follows:

Here, a transmission wheel such as a gear and a frictional gear is used as the transmission mechanism 63. As the output mechanism 64, a shutter driving mechanism and a lens driving mechanism are used in [cause] the case of a camera, for example, a needle driving mechanism and a calendar driving mechanism are used in case of an electronic watch, and a cutter feeding mechanism and a workpiece feeding mechanism are used in case of a work machine.

Paragraph beginning at line 7 of page 37 has been amended as follows:

As described above, according to the invention, [as] [described in Claim 1,] the inventive ultrasonic motor is arranged such that the polarized portion of the first piezoelectric body and the polarized portion of the second piezoelectric body stretch respectively in the polarizing direction so that stretching vibration and bending vibration are produced by overlapping the respective vibrations in the longitudinal direction[, the]. The output may be increased by utilizing the vibration in the longitudinal direction caused by the piezoelectric longitudinal effect and electrical energy may be utilized very efficiently.

Paragraph beginning at line 24 of page 37 has been amended as follows:

According to the invention, [as described in Claim 2,] a driving force in [the] both normal and reverse directions may be obtained and the output may be controlled by displacing the bending vibration or by changing the phase because the elliptic vibration for rotating in the reverse direction is taken out by causing bending vibration having a different phase or by amplifying the bending vibration by exciting the second polarized portion with a phase different from the first polarized portion in the same time.

Paragraph beginning at line 8 of page 38 has been amended as follows:

According to the invention, by providing a third piezoelectric body which vibrates in the same phase with the stretching vibration, [invention as described in Claim 3,] the high-output ultrasonic motor may be realized because the stretching vibration is amplified.

Paragraph beginning at line 11 of page 38 has been amended as follows:

According to the invention, by providing a third polarized portion that vibrates in the same phase with the stretching vibration, [invention as described in Claim 4,] the high-output ultrasonic motor may be realized because the stretching vibration is amplified.

Paragraph beginning at line 14 of page 38 has been amended as follows:

According to the invention [as described in Claim 5,] by abutting the moving body to the laminated piezoelectric vibrator in the horizontal direction, the moving body may be moved in the horizontal direction of the piezoelectric vibrator.

Paragraph beginning at line 17 of page 38 has been amended as follows:

According to the invention [as described in Claim 6,] by abutting the laminated piezoelectric vibrator at least at one point of a spherical moving body of the ultrasonic motor, the spherical moving body may be moved arbitrary.

Paragraph beginning at line 19 of page 38 has been amended as follows:

According to another aspect of the invention, [as described in Claim 7, the] an electronic apparatus using the ultrasonic motor may be realized.

IN THE CLAIMS:

Kindly amend claim 1 as follows:

1. (Amended) An ultrasonic motor having [for moving] a [moving body] movable member frictionally driven by [utilizing] ultrasonic vibration of a vibrating body, the ultrasonic motor comprising: [said] a vibrating body polarized in a given direction and comprised of a first piezoelectric body, a second piezoelectric body laminated to the first piezoelectric body in a preselected direction generally parallel to the polarized direction, and a third piezoelectric body disposed between the first and second piezoelectric

bodies, each of the [being composed of piezoelectric vibrators in which a plurality of piezoelectric bodies are laminated as a whole, wherein said piezoelectric bodies being a] first and second piezoelectric bodies [body] having a first polarized portion and [a second piezoelectric body that is laminated with said first piezoelectric body in the longitudinal direction parallel to the polarizing direction and having a first polarized portion] a second polarized portion, the first polarized portion of the first piezoelectric body being aligned in the preselected [longitudinal] direction with the second polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the first polarized portion of the second piezoelectric body, and the second polarized portion of the first piezoelectric body being aligned in the preselected [longitudinal] direction with the first polarized portion of the second piezoelectric body and being disposed in non-overlapping relation with the second polarized portion of the second piezoelectric body; and a [at position separated from said first polarized portion of said first piezoelectric body in the transverse direction vertical to the polarizing direction; and said moving body] movable member frictionally driven [being moved] by a combination of a [vibration obtained by combining] stretching vibration and a bending vibration [caused by] generated by applying a driving

signal having a first phase to the [vibrations of said] first polarized portions [portion] of the [said] first and second piezoelectric bodies and applying a driving signal having a second phase different from the first phase to the second polarized portions of the first and second piezoelectric bodies, the third piezoelectric body undergoing vibration in a phase identical to that of the stretching vibration [body and said first polarized portion of said second piezoelectric body in the polarizing direction].

FIG. 3A

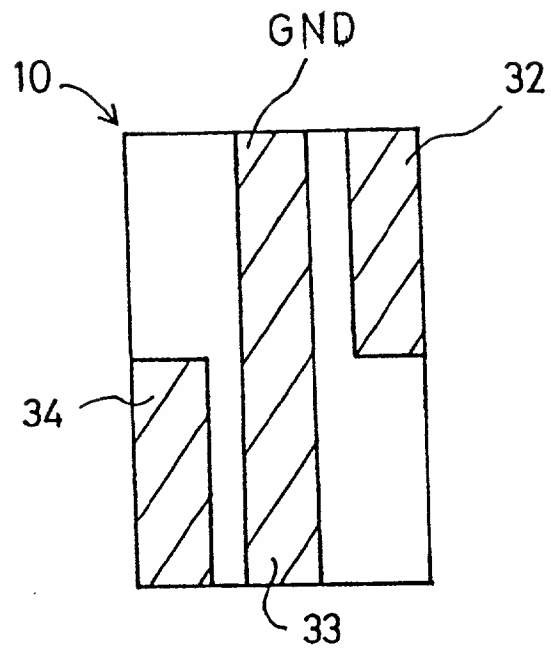


FIG. 3B

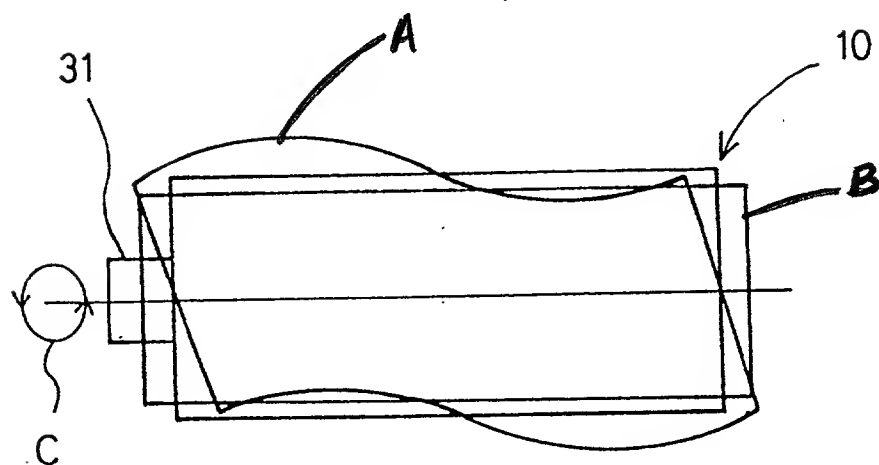
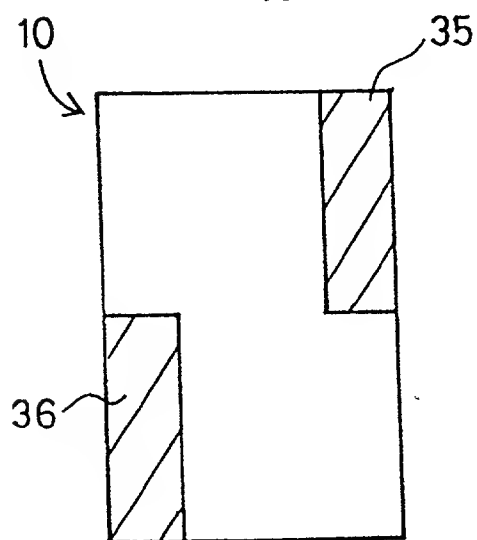


FIG. 4

FIG. 5A

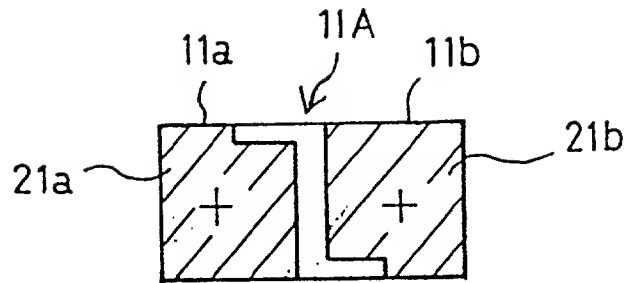


FIG. 5B

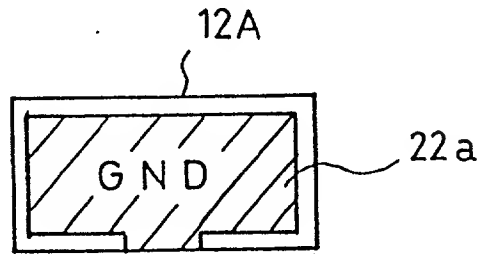


FIG. 5C

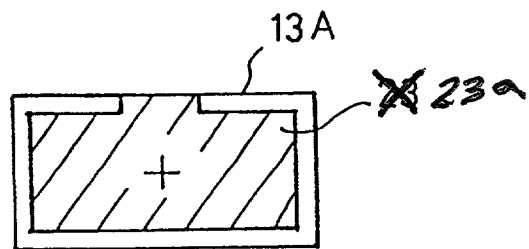


FIG. 5D

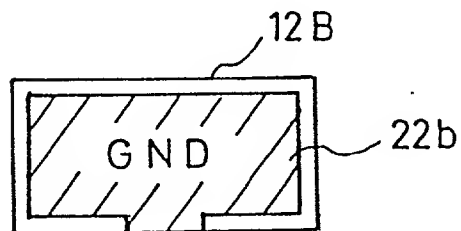


FIG. 5E

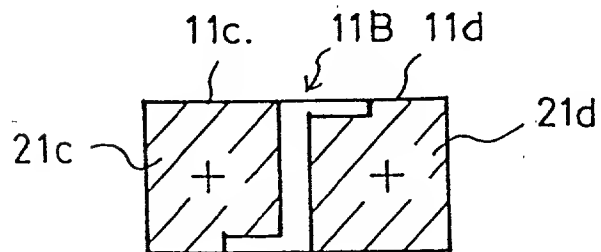
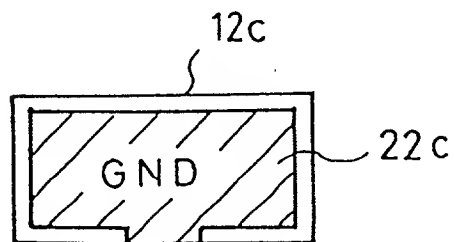


FIG. 5F



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Application of :
Akihiro IINO et al. :
Serial No. [not yet assigned -- :
Rule 53(b) :
Continuation of :
Application S.N. :
09/177,455 :
filed June 15, 2000] : Group Art Unit - 2834
Filed: November 21, 2001 : Examiner - Peter Medley
For: ULTRASONIC MOTOR AND :
ELECTRONIC APPARATUS :
EQUIPPED WITH ULTRA- :
SONIC MOTOR : Docket No. S004-3509 (CON)

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COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, DC 20231

**INFORMATION DISCLOSURE STATEMENT
UNDER PATENT RULES 97 AND 98**

S I R:

Applicants submit this information disclosure statement pursuant to 37 CFR §§1.97 and 1.98.

The present application is a Rule 1.53(b) continuation of parent application Serial No. 09/177,455, and the patents, publications or other information cited by or submitted to the PTO in the parent application are incorporated herein as applicants' information disclosure statement.

BY EXPRESS MAIL ON NOVEMBER 21, 2001 (ET 256 765 549 US)

This application has not received a first Office Action on the merits. Accordingly, this information disclosure statement is being filed under 37 CFR §1.97(b)(3), i.e., before the mailing date of a first Office Action on the merits.

Information Disclosure Statement

Pursuant to 37 CFR §1.98(a)(1), a list of patents, publications or other information submitted for consideration by the PTO is provided on annexed Form PTO-1449. Pursuant to 37 CFR §1.98(d), legible copies of each item of information listed on the Form were provided by the Examiner in the parent application.

Consideration of this information disclosure statement is respectfully requested.

Respectfully submitted,

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FORM PTO-1449

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.

S004-3509(CON)

SERIAL NO.

not yet assigned

LIST OF PRIOR ART CITED BY APPLICANT

APPLICANT

Akihiro IINO et al.

FILING DATE

November 21, 2001

GROUP

2834

U.S. PATENT DOCUMENTS

* CLASS	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
AA	5 3 4 5 1 3 7	9/1994	Funakubo et al.	310	323	
AB	5 4 5 3 6 5 3	9/1995	Zumeris	310	323	
AC	5 6 1 6 9 8 0	4/1997	Zumeris	310	323	
AD	5 6 8 2 0 7 6	10/1999	Zumeris	310	323	
AE	5 8 7 7 5 7 9	3/1999	Zumeris	310	317	
AF						
AG						
AH						
AI						
AJ						
AK						

FOREIGN PATENT DOCUMENTS

CLASS	DOCUMENT NO.	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
						YES	NO
AL	3 8 3 3 3 4 2	5/1990	Germany	--	--		X
AM	2 0 0 7 8 7 5	6/1988	Japan	--	--		X
AN	2 0 4 1 6 7 3	7/1988	Japan	--	--		X
AO							
AP							
AQ							

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

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EXAMINER:

DATE CONSIDERED:

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include a copy of this form with next communication to applicant.